AUTO NODE

792 & 793

KAY ELEMETRICS CORP

TEAR OFF

INSTRUCTION MANUAL JULY 1970

# AUTO-NODE

## MODEL 792A1

OFFICIAL RECORDS STATION
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FACILITIES FEB 1 0 1975

KAY ELEMETRICS CORP
12 Maple Avenue
Pine Brook, New Jersey
201-227-2000

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SECTION I

GENERAL INFORMATION

## 1.1 INTRODUCTION

The Model 792A1 is a fast acting, sensitive measuring set used to check the noise in a system against a known, controlled noise level. Any changes in system noise are indicated on the direct reading panel meter. The meter is calibrated to read the measured noise figure.

The tuned input amplifier is approximately 5 MHz wide at center frequencies from 10 to 170 MHz and approximately 10 MHz wide at centers from 170 to 250 MHz. The response of the 792A1 at 270 MHz is less than 3 db down. The amplifier frequency is continuously variable in 12 overlapping bands. The input covers a 0 dbm to -70 dbm range and requires approximately 35 db of gain after the 6 db noise generator.

The 792A1 contains a 41 db built in attenuator and a 40 db AGC system. The unit is self-calibrating to accommodate long term variations in system gain. It may also be operated manually. Another model the 792A2 which supplies preset TV channel frequencies is also available.

The resistive element noise source (Model 7921A1) covers the 10 to 1000 MHz range with 6 db of excess noise and a VSWR of better than 1.2 to 1. Automatic measurements may be made over a 0 to 20 db scale. Additional solid-state and waveguide sources provide coverage up to the microwave frequencies.

## 1.2 SPECIFICATIONS

### A. MODEL 792A1 NOISE METER

INPUT FREQUENCY: 10 - 250 MHz, center frequency. ( 3db down at 270 MHz.)

Continuously variable, 12 bands.

INPUT IMPEDANCE: 50 Ω (75 Ω optional), type N or F connector.

INPUT BANDWIDTH: Nominal 5 MHz 10 to 170 MHz; nominal 10 MHz 170 to 250 MHz.

INPUT RANGE & SENSITIVITY: 0 to -70 dbm (nominal 5 MHz bandwidth) 35 db of gain after 6 db source.

INPUT ATTENUATOR: 0 to 41 db in 1 db steps.

INPUT AGC: 40 db.

NOISE FIGURE RANGE: 0 to 20 db for 6 db reference; 3 to 30 db for gas tube and solid state sources.

NOISE FIGURE ACCURACY: ±0.5 db.

B. NOISE REFERENCE MODEL 7921A1

FREQUENCY RANGE: 10 to 1000 MHz.

INPUT IMPEDANCE: 50 (75) Ω, N or F Connector.

EXCESS NOISE OUTPUT: 6 db.

ACCURACY: ±0.2 db, 10 to 250 MHz; ±0.25 db, 250 to 500 MHz; ±0.3 db, 500 to 1000 MHz.

VSWR: Better than 1.2:1.

C. TV CHANNEL INPUTS MODEL 792A2

Input selector set for TV channels (IF to channel 13, two optional high bands to 260 MHz and 2 optional low bands) rather than the 10 to 250 MHz range normally supplied.

D. SPECIAL PURPOSE HEADS

Solid-state sources available.

Gas tube sources available (require pulsing power supply).

## 1.3 INSTALLATION

As soon as the Model 792A1 is recieved, visually check it to ascertain that it was not damaged during shipment. Any damage should be reported to the shipper and Kay Elemetrics Corp.

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The 792A1 is supplied with all circuits necessary for noise measurement. Specific noise sources are customer designated. Auxilliary cables and equipment are not supplied.

It is recommended that the unit be installed so as not to obstruct the ventillating grating.

The equipment will operate at optimum levels if extremes in temperature and humidity are avoided.

SECTION II

OPERATION

## 2.1 OPERATING NOTES

The noise output impedance varies with the type of noise source being used. The input of the 792A1 may be either 50 or 75 ohms. Where impedances of the system differ substantially from that of the 792A1, the use of impedance matching devices is suggested. Equipment interconnections should be made with the proper impedance coaxial cables and connectors.

Typical interconnection is shown in Figure 2.1. Depending upon the device being tested and the noise source used, an auxilliary amplifier or attenuator may be necessary between the output of the device and the input of the 792A1.

## 2.2 FRONT PANEL CONTROLS

| CONTROL | POSITION | FUNCTION |
|---|---|---|
| COARSE FREQUENCY | 12 Position Rotary Switch | Selects a frequency corresponding to the approximate center of the device under test. |
| FINE | Variable | Used with the COARSE Control to tune to the exact center frequency of the device under test. Control is properly set when the LEVEL meter indicates a peak reading. |
| NF METER FUNCTION SWITCH | Calibrate | Used to set the AUTOMATIC NOISE FIGURE meter at infinity before measurements are made. |
| | Noise Figure | Noise measurements are made directly from the AUTOMATIC NOISE FIGURE meter when in the AUTO mode. |
| INPUT ATTENUATOR | 6 Steps | Precise steps of attenuation may be inserted to reduce the input noise level for on-scale readings of the AUTOMATIC NOISE FIGURE meter. |

| | | |
|---|---|---|
| SET TO INFINITY | Variable | Used to set the AUTOMATIC NOISE FIGURE meter at infinity when the FUNCTION switch is in the Calibrate position. |
| POWER SWITCH | OFF | The 792A1 is de-energized. |
| | MAN | Used when manual noise figure measurements are made. |
| | AUTO | The AUTOMATIC NOISE FIGURE meter constantly monitors the noise figure of the device under test. |
| NF METER TIME CONSTANT (S-3) (Located on rear apron) | Fast | Provides the AUTOMATIC NOISE FIGURE meter with a relatively fast response. (Not associated with the AGC time constant.) |
| | Slow | Damps the AUTOMATIC NOISE FIGURE meter providing a slower response and more filtering of noise spikes. (Not associated with the AGC time constant.) |
| GAIN | Variable | Controls the gain of the 792A1 amplifiers for making manual noise figure measurements. |

## 2.3 TERMINALS

| TERMINAL | FUNCTION |
|---|---|
| NOISE OUTPUT | The noise output from the noise source is available at this jack. |
| INPUT | The output of the unit under test is fed into this jack. |

## 2.4 OPERATION WITH RESISTIVE ELEMENT NOISE SOURCE

A. Interconnect equipment as shown in Figure 2.1.

B. Switch out all attenuation.

C. Use the COARSE Control to select a frequency corresponding to the output frequency of the unit being tested.

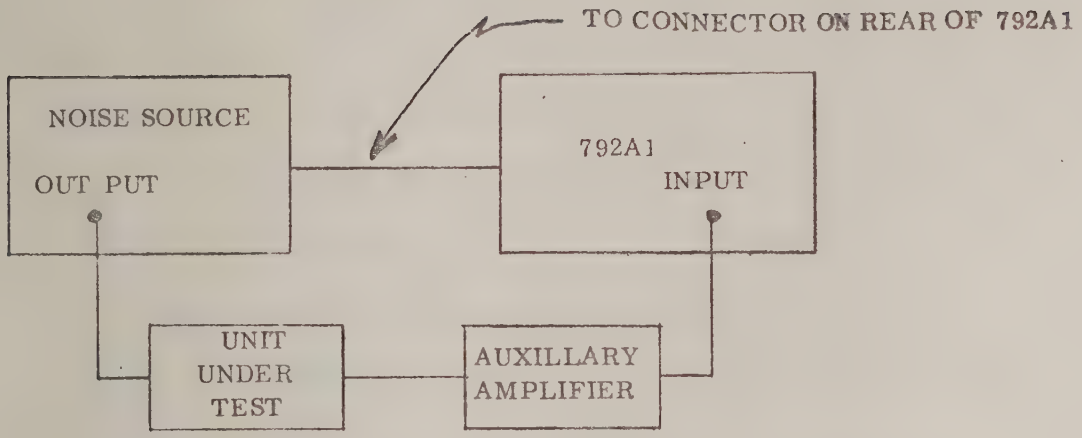



FIGURE 2.1, TYPICAL INTERCONNECTION DIAGRAM

D. Switch in attenuation until the NOISE POWER LEVEL meter reads approximately mid-scale.

E. Adjust the FINE control for a peak reading on the NOISE POWER LEVEL meter.

F. Switch in attenuation until the NOISE POWER LEVEL meter is reading in the OPERATE area. (If a wide band amplifier is being tested, the meter reading should be kept below half scale to avoid overloading the 792A1 input amplifier).

G. Place the NF METER FUNCTION switch in the CALIBRATE Position.

H. Adjust the SET TO INFINITY control until the AUTOMATIC NOISE FIGURE meter reads infinity.

I. Switch the NF Meter Function switch to Noise Figure.

J. The noise figure may be read directly from the second noise source scale (6 db at center of scale) of the AUTOMATIC NOISE FIGURE meter.

K. Use switch at rear of 7921A1 to select the operating frequency range.

L. Turn 7921A1 off when not in use to prolong life of hot wire source.

## 2.5 OPERATION WITH MICROWAVE NOISE SOURCES

NOTE: The gas tube noise sources consist of the NM-781, 261-A, 271-A, 281-A, 291-A, 301-A, 521-A, and 531-A. They all operate in conjunction with the pulsing power supply Model 324.

### A. AUTOMATIC OPERATION

1. Interconnect the equipment as shown in Figure 2.2.
2. Turn the NF METER FUNCTION switch to the CALIBRATE position. Switch the OFF-MAN-AUTO switch to AUTO.
3. Turn the Model 324 ON and to AUTO.
4. Allow the 324 a short warm up period. The gas tube should now fire and the peak current will be indicated on the TUBE CURRENT meter.
5. Adjust the tube current for 175 ma (indicated by SET on the meter).

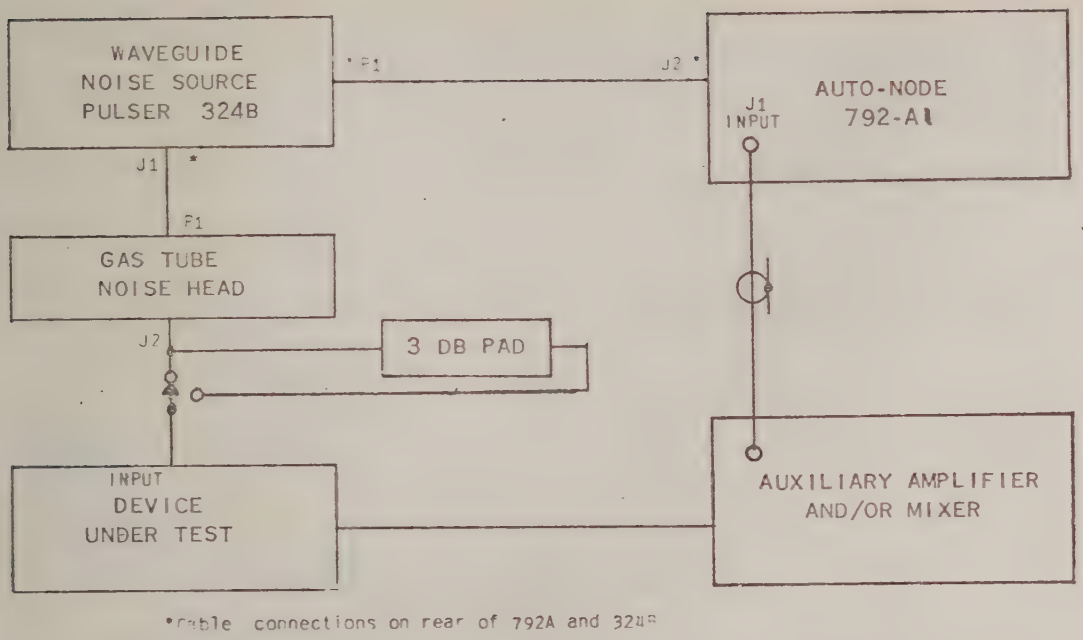



FIGURE 2.2, INTERCONNECTIONS FOR WAVEGUIDE NOISE SOURCES

6. Tune and calibrate the 792A1 as per steps 1 thru 9 of SECTION 2.4.

7. Turn the NF METER FUNCTION switch on the 792A1 to NOISE FIGURE and readjust the tube current to 175 ma, if necessary. Use the NOISE TUBE CURRENT control (Model 324) for this adjustment.

8. Read the noise figure directly from the top (15.2 db excess noise) scale on the AUTOMATIC NOISE FIGURE METER.

B. MANUAL OPERATION

METHOD 1

1. Interconnect the equipment as shown in Figure 2.2.

2. Turn the 792A1 to MAN and NOISE FIGURE.

3. Turn the 324 to MAN ON. The 324 must be in AUTO for the gas tube to initially fire. Then and only then will the tube fire when the 324 is turned to MAN ON.

4. Adjust the tube current to 175 ma.

5. Adjust the GAIN control on the 792A1 until the AUTOMATIC NOISE FIGURE METER reads infinity.

6. Turn the 324 to MAN OFF.

7. The noise figure may be read directly from the top scale of the AUTOMATIC NOISE FIGURE METER.

METHOD 2

1. Connect the noise source to be tested to make an automatic measurement.

2. Turn the equipment ON and allow for a short warm up period.

3. Turn the 792A1 to MAN and CALIBRATE.

4. Turn the Model 324 to MAN ON and adjust the tube current to 175 ma.

5. Turn the 324 to MAN OFF.

6. Adjust the 792A1 GAIN control for a reading of 1 ma on the current scale of the AUTOMATIC NOISE FIGURE METER.

7. Turn the 324 to MAN ON and insert 3 db of attenuation in the 792A1. Record the current reading. Call this reading (I).

8. Calculate the noise figure by using the following formula:

$$F = 10 \text{ Log}_{10} \frac{Fs - 1}{(2I - 1)}$$

$F_s - 1$ = Excess noise of the tube as a multiplier (not db).

9. This method can be made more accurate by using a pad or attenuator, after the 792A1, which will give a value of I closer to 1 ma than the reading of step 7. The procedure is the same as for 3 db except the formula changes.

$$F = 10 \text{ Log}_{10} \frac{Fs - 1}{(aI - 1)}$$

a = amount of attenuation, used as a multiplier (not db).

METHOD 3

1. Interconnect the equipment as shown in Figure 2.2.

2. Turn the 792A1 to MAN and CALIBRATE.

3. Turn the 324 to AUTO and allow to warm up.

4. Turn the 324 to MAN ON and adjust the tube current to 175 ma.

5. Adjust the GAIN control on the 792A1 until the AUTOMATIC NOISE FIGURE METER reads infinity.

6. Insert a pad of attenuation between the noise source and the device under test.

7. Record the reading on the current scale and convert the reading to an s factor by the formula $(s = \frac{2}{I})$.

8. Calculate the noise figure from the formula:

$$F = 10 \text{ Log}_{10} (F_s - 1) \frac{(a - s)}{as (-1)}$$

$(F_s - 1)$ = Excess noise of noise source.

$(F_s - 1) = 33.1$ for an excess noise of 15.2 db.

a = a multiplier (not db).

SECTION III

CIRCUIT DESCRIPTION

## 3.1 OVERALL CIRCUITRY

The basic circuits of the 792A1 include amplifying, detecting, gating, and metering circuits: noise generators, and appropriate power supplies. A functional diagram is included at the end of the section.

### AMPLIFIER & DETECTOR CIRCUITS

The input of the 792A1 connects through a switched attenuator to an AGC'd, wide band, amplifier (Q301-306) and diode attenuator (CR301-304). This is followed by a single-tuned, narrow band amplifier whose center frequency is variable over the 10 - 250 MHz range of the wideband input. The output of the amplifier is detected in a square law detector (CR307) and is then AC coupled to a 2 KHz wide video amplifier (Q113-119). The output of the video amplifier is clamped by a DC restorer (CR102) and fed to two synchronously operated gates--an AGC gate (Q119) and a Meter Circuit Gate (Q120).

### GATING CIRCUITS

The gates are operated synchronously with the noise source, and with the wide-band amplifier. A multivibrator (Q101 and 102) generates a 300 cycle gating pulse, and also pulses a bi-stable multivibrator (Q105 & 106) to produce a second gating pulse at 150 cycles. The 150 cycle pulse turns the noise source on and off.

During the second half of the on-time of the noise source the 300 cycle pulse turns on both the AGC Gate and wide Band Amplifier. The output pulse is fed to the AGC circuit and clamped at a constant value. During the second half of the off-time of the noise source the 300 cycle pulse turns on both the Meter Gate, and again, the wide Band Amplifier. The output pulse is fed to the calibrated meter circuit.

AGC CIRCUIT

The input stage of the AGC is a differential amplifier (Q109 - 112). One input is fed by the output of the AGC Gate through an emitter follower (Q108); the second input is a negative voltage obtained from the -6.8 volt regulated supply. This voltage is used as a reference for the AGC. The differential amplifier consists of two grounded emitter stages feeding emitter followers in double-ended fashion, to provide AGC voltages $180^{o}$ out of phase. One voltage controls the series diode in the diode attenuator; the other controls the shunt diodes and the wide Band Amplifier. The AGC loop acts on the diode attenuator and wide Band Amplifier to maintain the detected AGC Gate output equal to the reference voltage.

METER CIRCUIT

The meter is calibrated to read noise figure by measuring the detected output of the Meter Gate. The meter scale is based on the relationship:

$$F = \frac{F_s - 1}{\frac{N_2}{N_1} - 1}$$

where: F = Noise Figure

$F_s - 1$ = Excess Noise Power $\frac{T_h}{T_o} - 1$

$N_1$ = Noise OFF Power

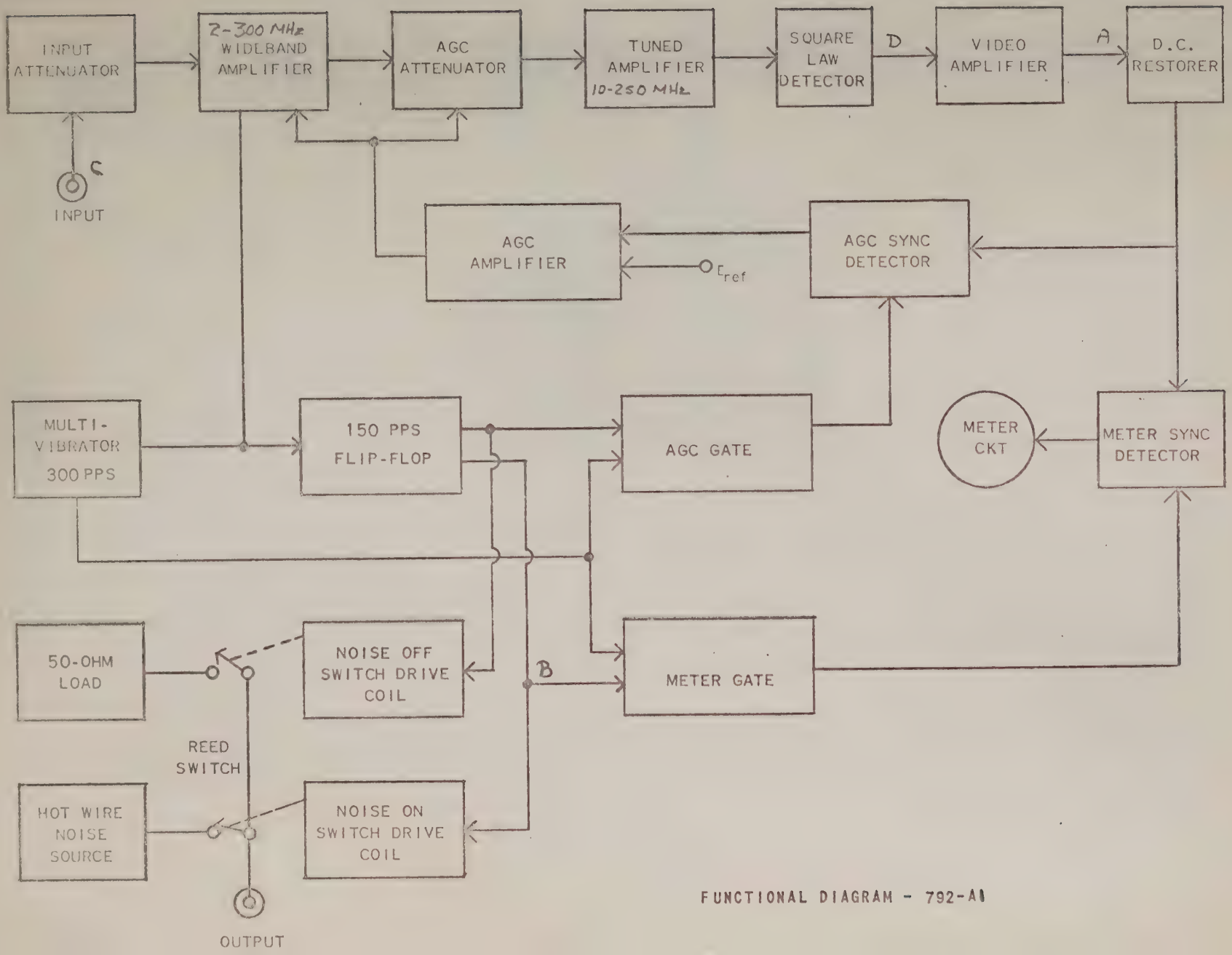
$N_2$ = Noise ON Power

$T_h$ = Hot body temperature of noise source ($^{o}$K)

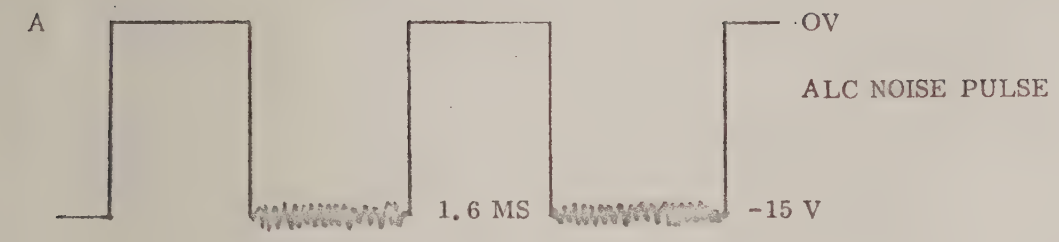
$T_o$ = Room temperature ($^{o}$K)

. . . . Since ($F_s$ - 1) is a constant for the particular noise source used and $N_2$ is held constant by the AGC Circuit, only $N_1$ varies and is monitored by the meter.

Calibration of the meter scale is performed by leaving the noise source on continuously while the gating circuits switch, as usual, between the AGC and Meter circuits. This establishes the "Infinity" noise figure, and the end of the calibrated scale.




FUNCTIONAL DIAGRAM - 792-A1



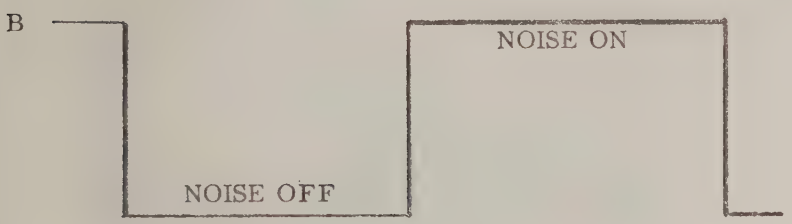



FIGURE 3.2, BLOCK DIAGRAM REFERENCES

C. Set the AUTOMATIC NOISE FIGURE METER to read infinity, using the SET TO INFINITY control. Then switch to MAN and set the meter to infinity with the GAIN control.

D. Insert 3 db of attenuation and adjust R365 until the meter reads 6 db (center scale).

E. Repeat the two preceding steps until no further adjustment is needed.

F. Remove the 3 db of Step D, and insert 1 db attenuation. The meter reading should fall between 21 on the top scale and 12 on the middle scale.

G. Insert an additonal 5 db of attenuation and see that the meter reads 0.5 on the current scale.

4.5 AGC ADJUSTMENT

A. Adjust R130 until the voltage on the base of Q112 is -3.4 volts (±0.1 volt). At the same time, keep the needle of the NOISE POWER LEVEL meter at the extreme left of the OPERATE zone by inserting attenuation from the input attenuator.

B. Observe the waveform at the junction of C105 and CR102; it should correspond to Figure 5.1.

C. Using the internal attenuator (and external attenuation, if necessary), adjust the input level so that it is just sufficient to maintain AGC action. At this level, the meter will no longer read infinity when 1 db of additional attenuation is inserted.

D. Now, take 40 db of attenuation out of the circuit. Adjust the Noise Power Meter Adj (R380) until the meter needle is at the extreme right of the OPERATE zone. (This requires a test amplifier with a gain of about 75 db at a bandwidth of 1 mc.)

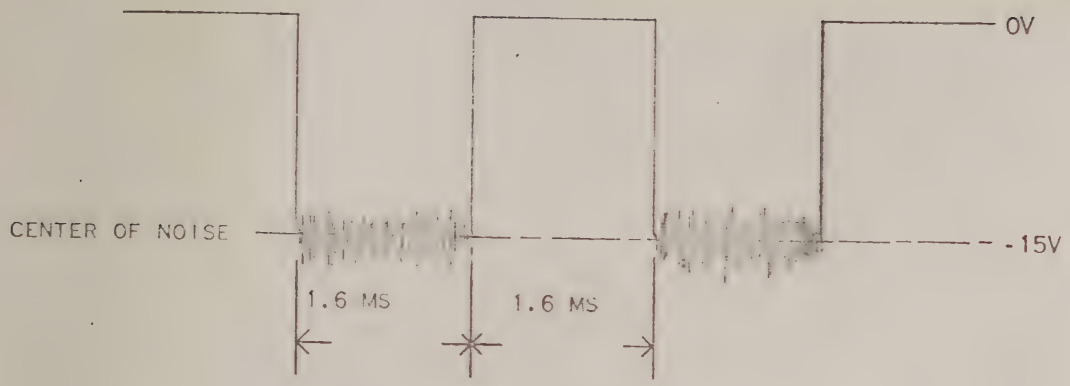
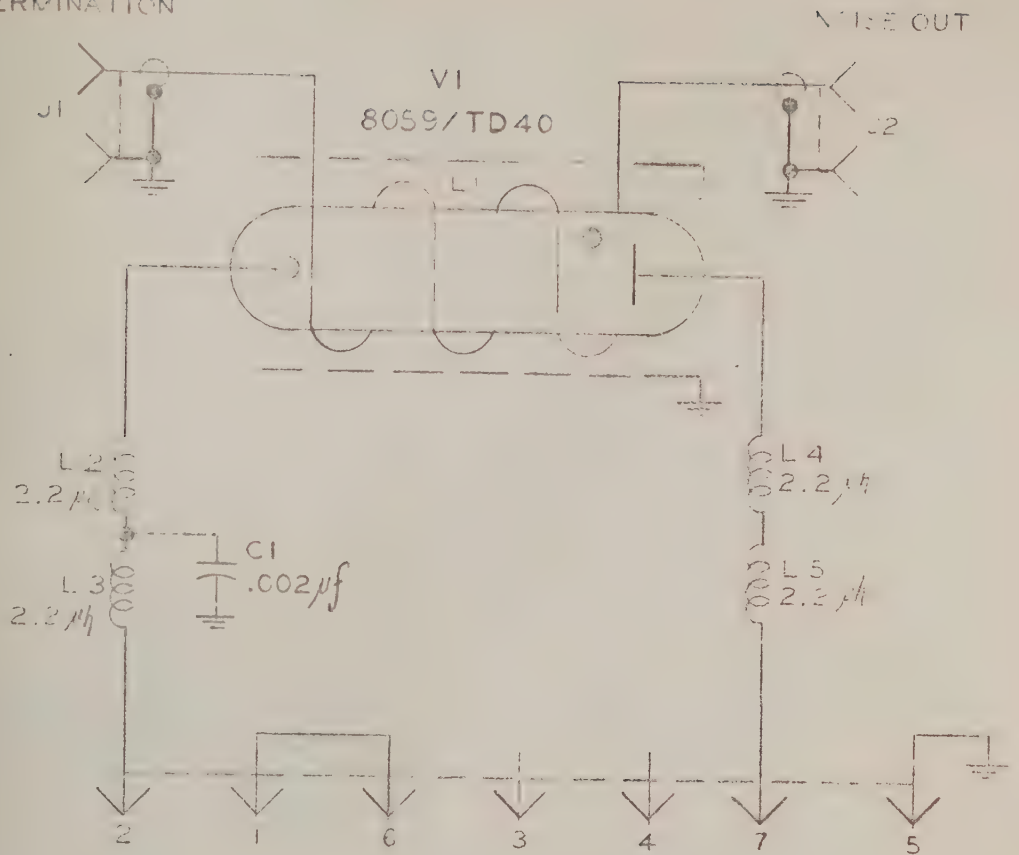



FIG. 4.1 - AGC NOISE PULSE

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(A-N792A)

SCHEMATIC COAXIAL GAS TUBE NOISE SOURCE NM 7A1

| MAT. | FINISH: | SCALE: |
|---|---|---|

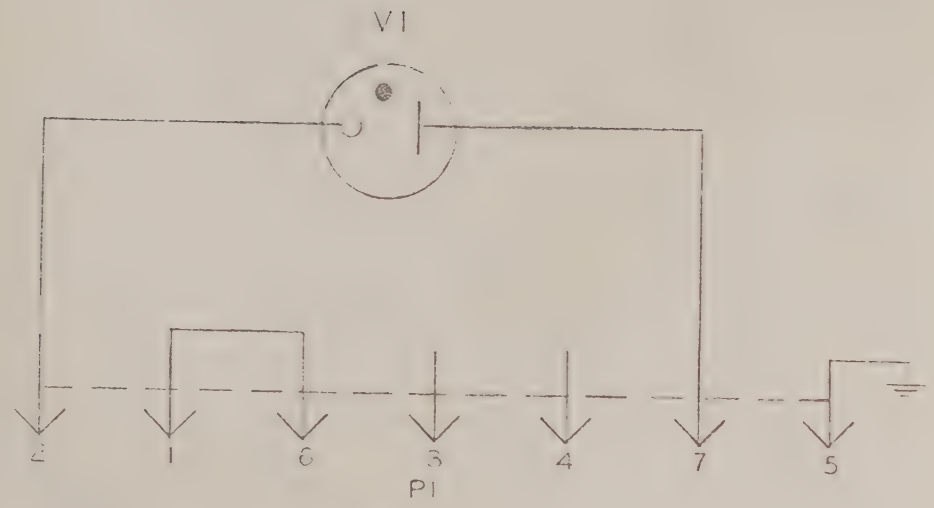
TOLERANCES UNLESS OTHERWISE SPECIFIED:
DECIMAL ± .005 FRACTIONAL ± 1/64 ANGULAR ± 30'

| CHANGE | DATE |
|---|---|
| | |

KAY ELECTRIC CO.
PINE BROOK, N. J.

DWN BY A.J.P. DATE
APP. BY DATE

DWG. NO. A8825




MATE TO J1
SCHEMATIC NO B8828

| FREQ (KMC) | WAVEGUIDE | TUBE (BENDIX) |
|---|---|---|
| 2.6 - 3.95 | RG 48/U | TD 38 |
| 3.95 - 5.85 | RG 49/U | TD 39 |
| 5.85 - 8.20 | RG 50/U | TD 39 |
| 7.05 - 10.00 | RG 51/U | TL 40 |
| 8.20 - 12.40 | RG 52/U | TD 40 |
| 12.40 - 18.00 | RG 91/U | TD 41 |
| 18.00 - 26.50 | RG 53/U | TD 42 |

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SCHEMATIC PULSED WAVEGUIDE NOISE SOURCE (A-N 792 A)

MAT. | FINISH: | SCALE:

TOLERANCES UNLESS OTHERWISE SPECIFIED:
DECIMAL ± .005 FRACTIONAL ± 1/64 ANGULAR ± 30 MIN.

| CHANGE | DATE | APP. |
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KAY ELECTRIC CO.
PINE BROOK, N. J.

DWN. BY AVP DATE 8/24/64
CHK. BY DATE

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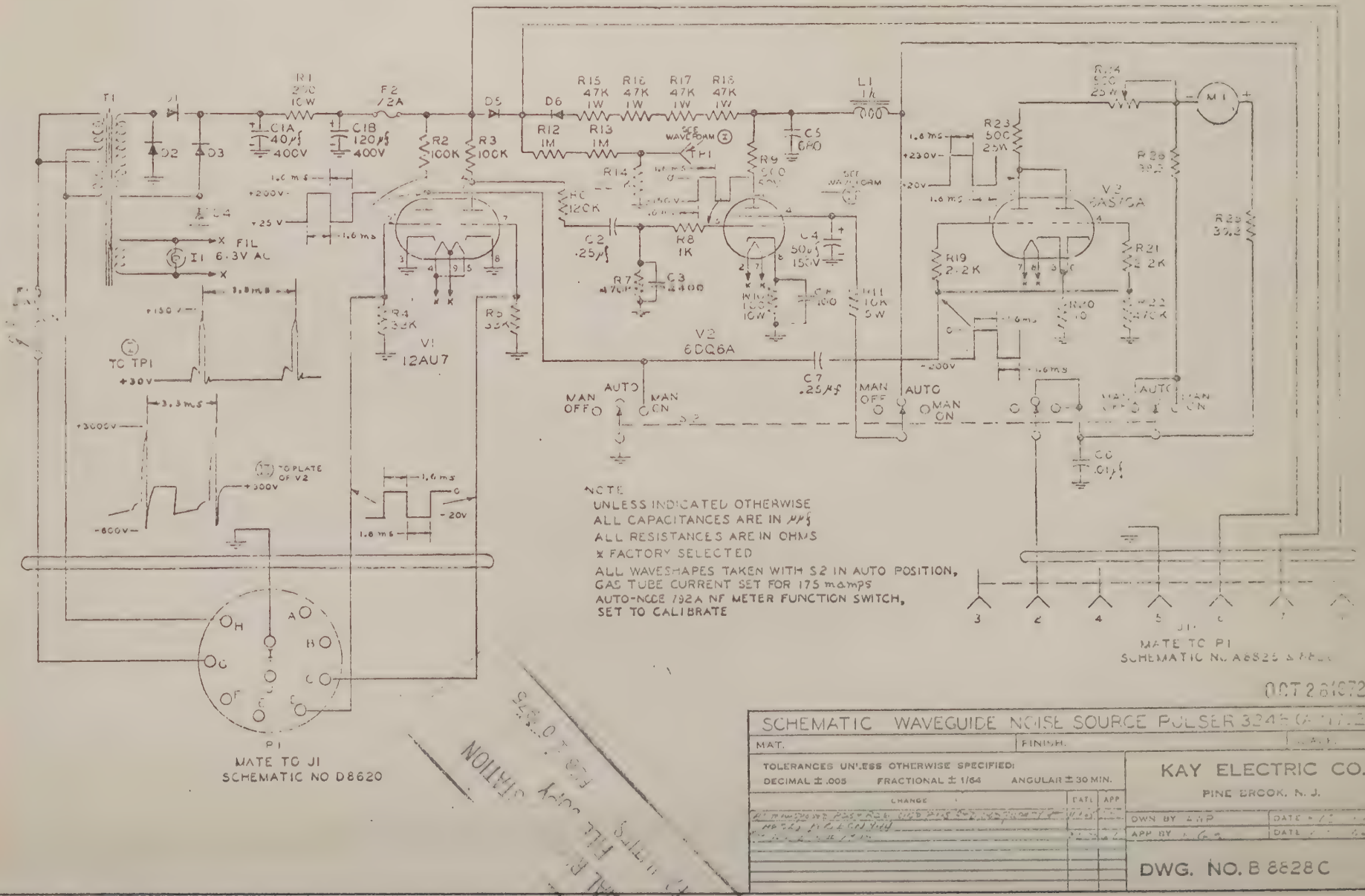


NOTE
UNLESS INDICATED OTHERWISE
ALL CAPACITANCES ARE IN µµf
ALL RESISTANCES ARE IN OHMS
* FACTORY SELECTED
ALL WAVESHAPES TAKEN WITH S2 IN AUTO POSITION, GAS TUBE CURRENT SET FOR 175 mamps
AUTO-NCCE 792A NF METER FUNCTION SWITCH, SET TO CALIBRATE

OCT 26 1972

SCHEMATIC WAVEGUIDE NOISE SOURCE PULSER 324[illegible]

MAT. | FINISH. | [illegible]

TOLERANCES UNLESS OTHERWISE SPECIFIED:
DECIMAL ± .005 FRACTIONAL ± 1/64 ANGULAR ± 30 MIN.

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KAY ELECTRIC CO.
PINE BROOK, N. J.

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DWG. NO. B 8828 C

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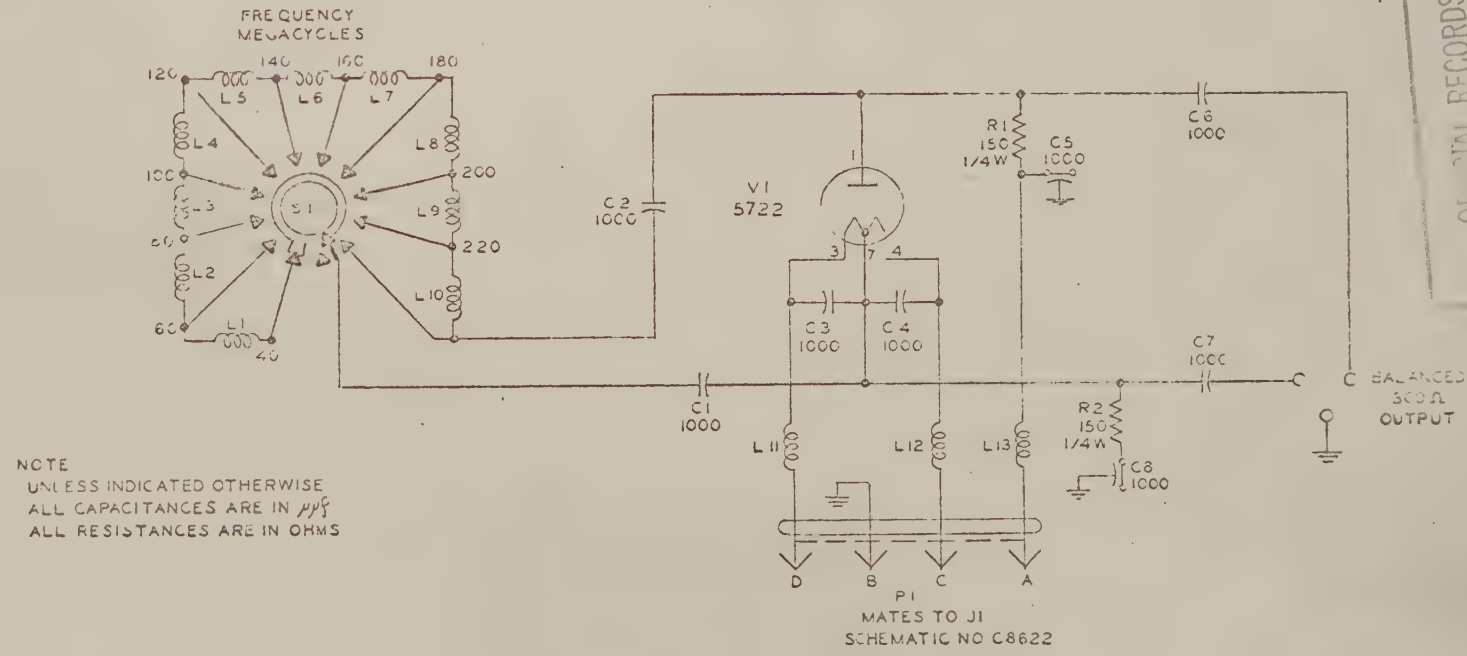


NOTE
UNLESS INDICATED OTHERWISE
ALL CAPACITANCES ARE IN μμf
ALL RESISTANCES ARE IN OHMS

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OCT 20

SCHEMATIC NOISE HEAD 300Ω BALANCED

MAT. FINISH:

TOLERANCES UNLESS OTHERWISE SPECIFIED:
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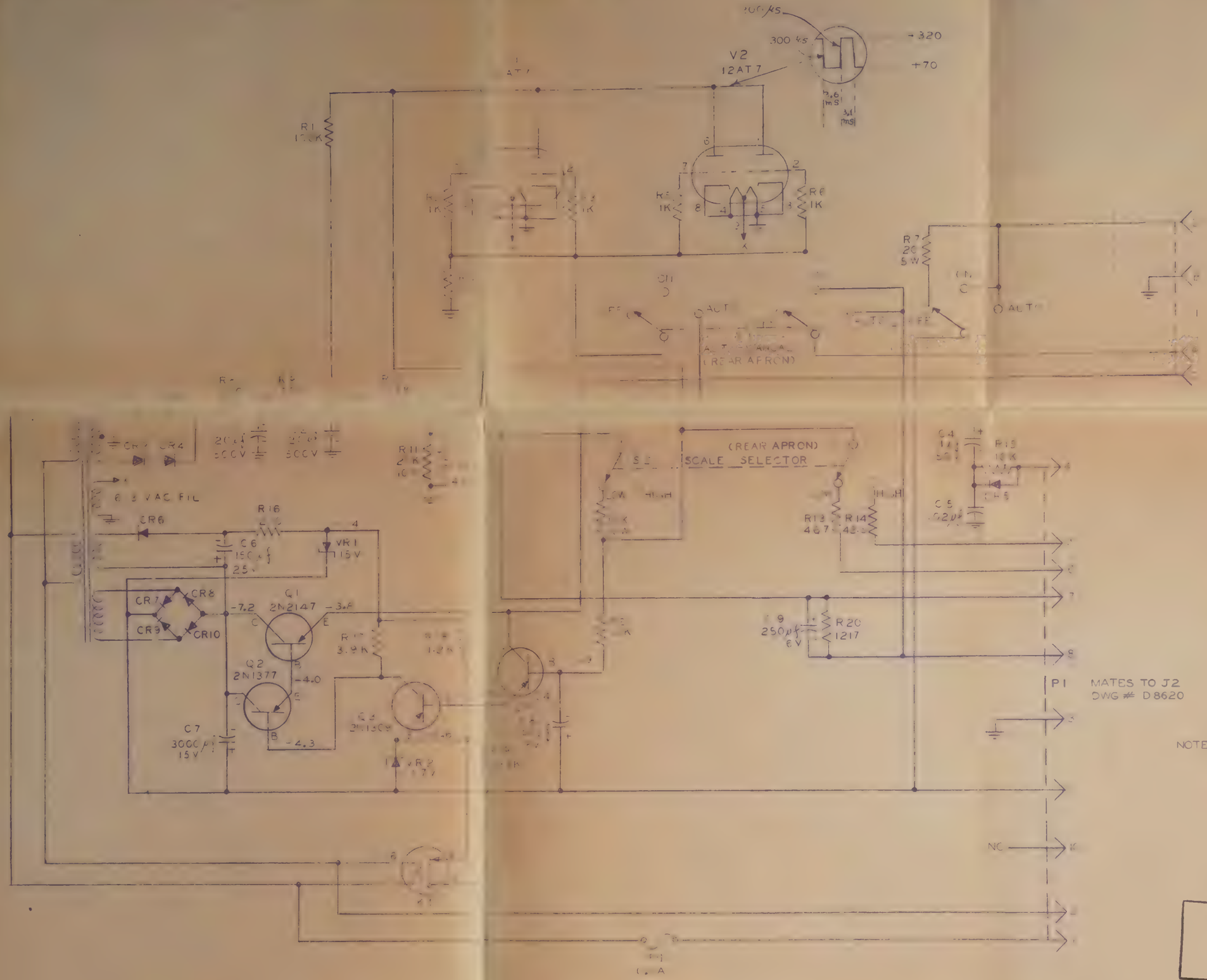


NOTE: ALL NEGATIVE VOLTAGES REFERENCED TO PIN 5

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SCHEMATIC NOISE DIODE PULSER AUTO-NODE MODEL 792A

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TOLERANCES UNLESS OTHERWISE SPECIFIED:
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| [illegible] | | |
| [illegible] | | |
| "C" PER E.N. # 892 | | |

KAY ELECTRIC CO.
PINE BROOK, N. J.

| DWN. BY AWP | DATE 5-13-[illegible] |
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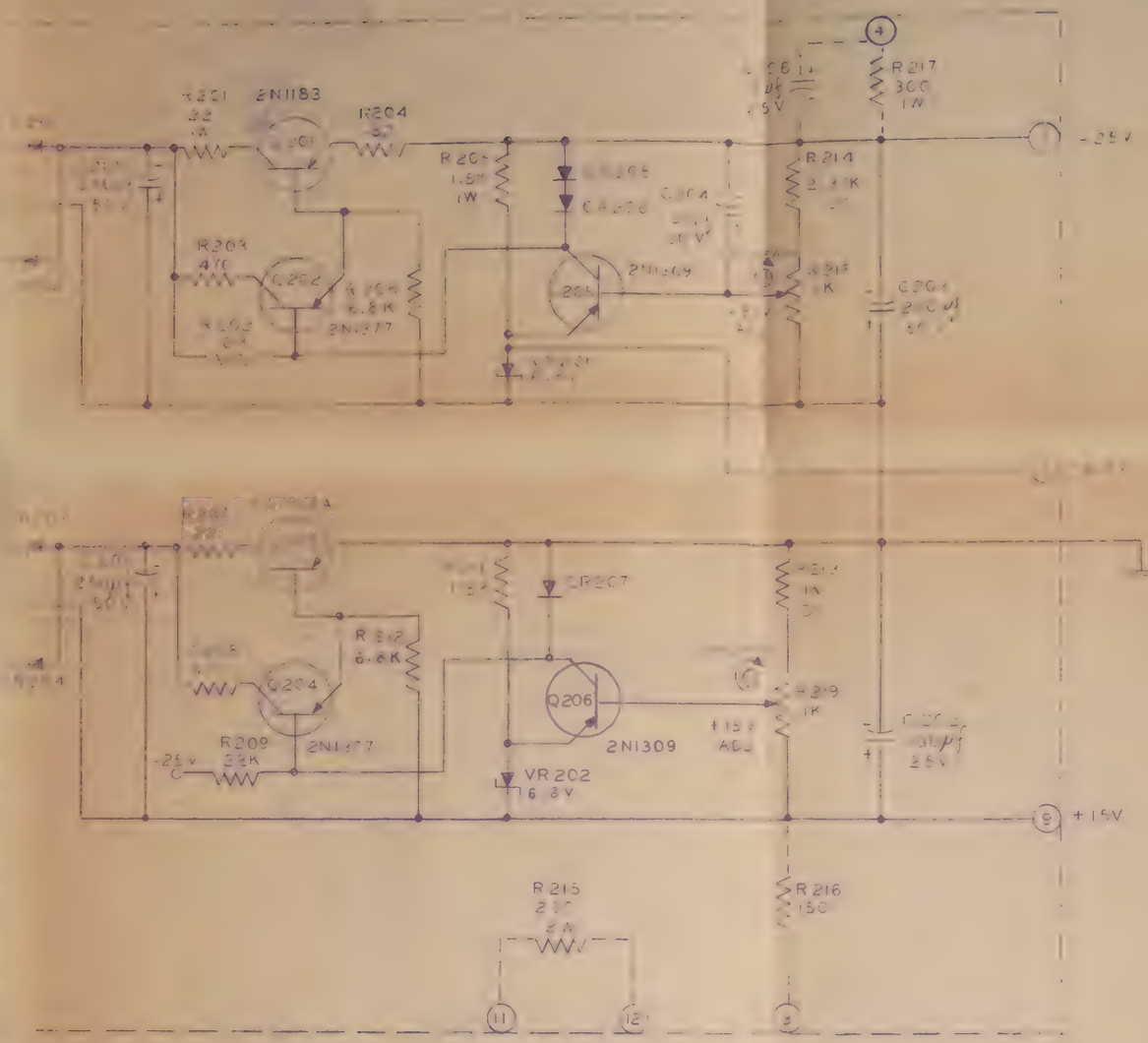
| APP. BY | DATE |

DWG. NO. D[illegible]

FUNCTION SWITCH
(4 POLES)
(FRONT PANEL)

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SCHEMATIC POWER SUPPLY AUTO-MODE MODEL 792 A

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TOLERANCES UNLESS OTHERWISE SPECIFIED:
DECIMAL ± .005 FRACTIONAL ± 1/64 ANGULAR ± 30 MIN.

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PINE BROOK, N. J.

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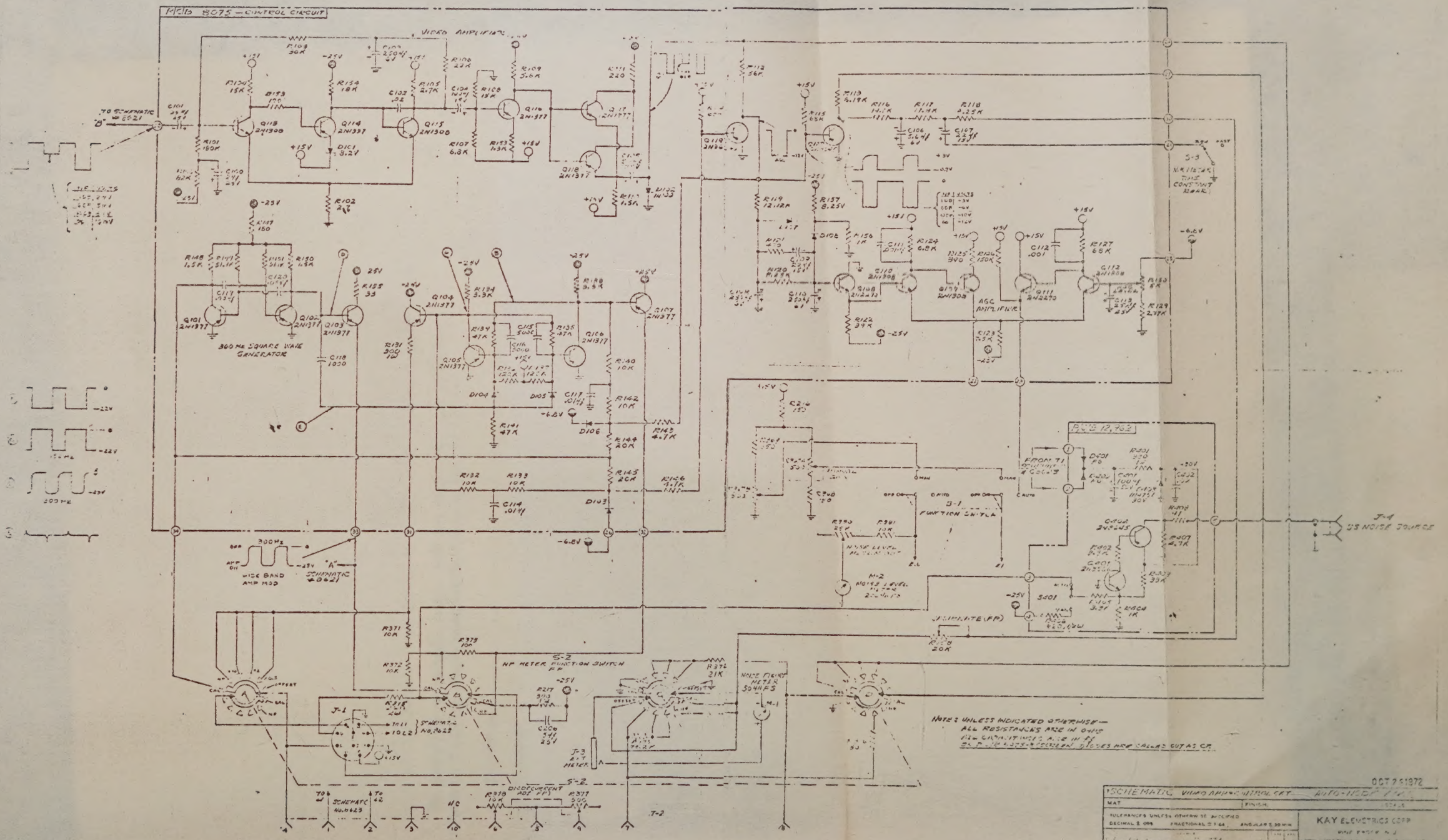
MOD 8075 — CONTROL CIRCUIT
VIDEO AMPLIFIER
TO SCHEMATIC "D" #6621
300 MC SQUARE WAVE GENERATOR
200 MC
WIDE BAND AMP MOD
SCHEMATIC #8621
S-2 NF METER FUNCTION SWITCH
NOISE FIGURE METER SCALES
J-1
J-2
J-3 A-T METER
J-4 US NOISE SOURCE
S-3 VARIABLE TIME CONSTANT BOARD
AGC AMPLIFIER
S-1 FUNCTION UNIT A
FROM T1 SCHEMATIC #6623
LIMITER (FP)
NOTE: UNLESS INDICATED OTHERWISE— ALL RESISTANCES ARE IN OHMS ALL CAPACITANCES ARE IN MF
SCHEMATIC VIDEO AMPLIFIER CKT — AUTO-NOISE FIG.
KAY ELECTRICS CORP
DWG. NO. 8622-T
OCT 25 1972

TEAR OFF AT THIS LINE

792 798

We would like to maintain contact with the people who use or fix our instruments. Would you please complete the following and return to us–

Your Name.....

Company .....

Div. or Dept. .....

Street .....

City, Zone, State .....

Telephone No. .....

Do you use this instrument? ..... ☐

Maintain or repair it? ..... ☐

Should we be doing something to help you?.....

.....

.....

Send extra manual on Model.....

Send general data..... ☐